

CLAIMS

We claim:

- [c1] 1. A vehicle system comprising:
a flammability control system configured to suppress the development of flammable vapors in a fuel tank of a vehicle; and
a controller operably coupled to the flammability control system, wherein the controller is configured to receive one or more signals relating to a condition of the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the one or more signals.
- [c2] 2. The vehicle system of claim 1 wherein the controller is configured to receive a temperature signal relating to a temperature condition of the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the temperature signal.
- [c3] 3. The vehicle system of claim 1 wherein the controller is configured to receive a temperature signal relating to a temperature of a wall of the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the temperature signal.
- [c4] 4. The vehicle system of claim 1 wherein the controller is configured to receive a temperature signal relating to an air temperature outside the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the temperature signal.
- [c5] 5. The vehicle system of claim 1 wherein the controller is configured to receive a temperature signal relating to a fluid temperature inside the fuel tank,

and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the temperature signal.

[c6] 6. The vehicle system of claim 1 wherein the controller is configured to receive a pressure signal relating to a pressure condition of the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the pressure signal.

[c7] 7. The vehicle system of claim 1 wherein the controller is configured to receive a pressure signal relating to an air pressure outside the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the pressure signal.

[c8] 8. The vehicle system of claim 1 wherein the controller is configured to receive a pressure signal relating to a fluid pressure inside the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the pressure signal.

[c9] 9. The vehicle system of claim 1 wherein the controller is configured to receive a fuel level signal relating to the amount of fuel in the fuel tank, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the fuel level signal.

[c10] 10. The vehicle system of claim 1 wherein the controller is configured to reduce power to the flammability control system when the one or more signals indicate that the level of flammable vapors in the fuel tank is at or below a preselected limit.

[c11] 11. The vehicle system of claim 1 wherein the controller is configured to reduce power to the flammability control system when the one or more signals

indicate that the probability of ignition in the fuel tank is at or below a preselected limit.

[c12] 12. The vehicle system of claim 1 wherein the controller is configured to reduce power to the flammability control system when the one or more signals indicate that an oxygen concentration level in the fuel tank is at or below a preselected limit.

[c13] 13. The vehicle system of claim 1 wherein the controller is configured to reduce power to the flammability control system when the one or more signals indicate that an oxygen concentration level in the fuel tank is at or below about 18%.

[c14] 14. The vehicle system of claim 1 wherein the controller is configured to reduce power to the flammability control system when the one or more signals indicate that an oxygen concentration level in the fuel tank is at or below about 12%.

[c15] 15. The vehicle system of claim 1 wherein the flammability control system includes a thermal control system configured to reduce the temperature of the fuel tank.

[c16] 16. The vehicle system of claim 1 wherein the flammability control system includes an air conditioning system configured to reduce the temperature of air proximate to the fuel tank to reduce the temperature of the fuel tank.

[c17] 17. The vehicle system of claim 1 wherein the flammability control system includes an inert gas system configured to flow inert gas into the fuel tank to reduce an oxygen concentration in the fuel tank.

[c18] 18. The vehicle system of claim 1 wherein the flammability control system includes an inert gas system configured to flow nitrogen gas into the fuel tank to reduce an oxygen concentration in the fuel tank.

[c19] 19. The vehicle system of claim 1 wherein the flammability control system includes an inert gas system configured to flow inert gas from at least one storage bottle into the fuel tank to reduce an oxygen concentration in the fuel tank.

[c20] 20. The vehicle system of claim 1 wherein the flammability control system includes an inert gas generating system configured to receive bleed air from an engine of an aircraft and flow inert gas from the bleed air into the fuel tank.

[c21] 21. The vehicle system of claim 1 wherein the flammability control system includes an inert gas generating system configured to receive bleed air from an engine of an aircraft and flow inert gas from the bleed air into the fuel tank, and wherein the controller is configured to control the flow of bleed air from the engine to the inert gas generating system at least partially in response to the one or more signals.

[c22] 22. The vehicle system of claim 1 wherein the flammability control system includes an inert gas generating system configured to receive bleed air from an engine of an aircraft and flow inert gas from the bleed air into the fuel tank, and wherein the controller is configured to reduce the flow of bleed air from the engine to the inert gas generating system when the one or more signals indicate that the level of flammable vapors in the fuel tank is at or below a preselected limit.

[c23] 23. The vehicle system of claim 1 wherein the one or more signals are fuel tank condition signals, wherein the controller is further configured to receive one or more aircraft operation signals relating to an operational phase of an aircraft, and wherein the controller is still further configured to control operation of the flammability control system in response to the one or more fuel tank condition signals and in response to the one or more aircraft operation signals.

[c24] 24. The vehicle system of claim 1 wherein the flammability control system is configured to suppress the development of flammable vapors in a fuel tank of an aircraft, and wherein the vehicle system further comprises:

a fuselage, wherein the fuel tank is positioned at least partially in the fuselage; and
a wing extending outwardly from the fuselage.

[c25] 25. The vehicle system of claim 1 wherein the controller is configured to control operation of the flammability control system at least partially in response to the one or more signals by changing the level of operation of the flammability control system.

[c26] 26. The vehicle system of claim 1 wherein the controller is configured to control operation of the flammability control system at least partially in response to the one or more signals by switching the flammability control system off.

[c27] 27. The vehicle system of claim 1 wherein the controller is configured to control operation of the flammability control system at least partially in response to the one or more signals by switching the flammability control system on.

[c28] 28. A vehicle system comprising:
a flammability control system configured to suppress the development of flammable vapors in a fuel tank of a vehicle; and

a controller operably coupled to the flammability control system, wherein the controller is configured to receive one or more signals relating to an operational phase of the vehicle, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the one or more signals.

[c29] 29. The vehicle system of claim 28 wherein the controller is configured to receive a signal from a landing gear system of an aircraft, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the signal from the landing gear system.

[c30] 30. The vehicle system of claim 28 wherein the controller is configured to receive a signal from an air conditioning system of the vehicle, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the signal from air conditioning system.

[c31] 31. The vehicle system of claim 28 wherein the controller is configured to receive a signal from an airspeed indicator of an aircraft, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the signal from the airspeed indicator.

[c32] 32. The vehicle system of claim 28 wherein the controller is configured to receive a signal from an altimeter of an aircraft, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the signal from the altimeter.

[c33] 33. The vehicle system of claim 28 wherein the controller is configured to receive a signal from a fire detection sensor of the vehicle, and wherein the controller is further configured to control operation of the flammability control system at least partially in response to the signal from the fire detection sensor.

[c34] 34. The vehicle of claim 28 wherein the one or more signals are aircraft operation signals, wherein the controller is further configured to receive one or more fuel tank condition signals relating to a condition of the fuel tank, and wherein the controller is still further configured to control operation of the flammability control system in response to the one or more fuel tank condition signals and in response to the one or more aircraft operation signals.

[c35] 35. A method for controlling a flammability control system, the method comprising:

operating the flammability control system at a first level of operation to suppress the development of flammable vapors in a fuel tank of a vehicle;

receiving one or more signals relating to a condition of the fuel tank;

when the one or more signals correspond to a first level of flammable vapors in the fuel tank, continuing to operate the flammability control system at the first level of operation; and

when the one or more signals correspond to a second level of flammable vapors in the fuel tank that is less than the first level of flammable vapors, at least reducing the operating level of the flammability control system from the first level of operation to a second level of operation that is less than the first level of operation.

[c36] 36. The method of claim 35 wherein at least reducing the operating level of the flammability control system includes switching the flammability control system off.

[c37] 37. The method of claim 35 wherein operating the flammability control system at a first level of operation includes flowing inert gas into the fuel tank, and

wherein at least reducing the operating level of the flammability control system includes stopping the flow of inert gas into the fuel tank.

[c38] 38. The method of claim 35 wherein operating the flammability control system at a first level of operation includes flowing inert gas into the fuel tank at a first flow rate, and wherein at least reducing the operating level of the flammability control system includes flowing inert gas into the fuel tank at a second flow rate that is less than the first flow rate.

[c39] 39. The method of claim 35 wherein receiving one or more signals relating to a condition of the fuel tank includes receiving a temperature signal.

[c40] 40. The method of claim 35 wherein receiving one or more signals relating to a condition of the fuel tank includes receiving a temperature signal relating to an air temperature outside the fuel tank.

[c41] 41. A method for controlling a flammability control system, the method comprising:

operating the flammability control system at a first level to suppress the development of flammable vapors in a fuel tank of a vehicle;

receiving one or more signals relating to a condition of the fuel tank;

when the one or more signals correspond to a first probability of ignition in the fuel tank, continuing to operate the flammability control system at the first level; and

when the one or more signals correspond to a second probability of ignition in the fuel tank that is less than the first probability of ignition, at least reducing the operating level of the flammability control system from the first level to a second level that is less than the first level.

[c42] 42. The method of claim 41 wherein operating the flammability control system at a first level includes flowing inert gas into the fuel tank, and wherein at least reducing the operating level of the flammability control system includes stopping the flow of inert gas into the fuel tank.

[c43] 43. A method for controlling a flammability control system, the method comprising:

operating the flammability control system at a first level of operation to suppress the development of flammable vapors in a fuel tank of a vehicle;

receiving one or more signals relating to an operational phase of the vehicle;

when the one or more signals correspond to a first level of flammable vapors in the fuel tank, continuing to operate the flammability control system at the first level of operation; and

when the one or more signals correspond to a second level of flammable vapors in the fuel tank that is less than the first level of flammable vapors, at least reducing the operating level of the flammability control system from the first level of operation to a second level of operation that is less than the first level of operation.

[c44] 44. The method of claim 43 wherein receiving one or more signals relating to an operational phase of the vehicle includes receiving a signal from a landing gear system of an aircraft.

[c45] 45. The method of claim 43 wherein operating the flammability control system at a first level of operation includes flowing inert gas into the fuel tank, wherein receiving one or more signals relating to an operational phase of the vehicle includes receiving a signal from a landing gear system of an aircraft, and

wherein at least reducing the operating level of the flammability control system includes at least reducing the flow of inert gas into the fuel tank when the one or more signals indicate that the aircraft is on the ground.

[c46] 46. The method of claim 43 wherein receiving one or more signals relating to an operational phase of the vehicle includes receiving a signal from a rate-of-climb indicator of an aircraft.

[c47] 47. A method for controlling a flammability control system, the method comprising:

 operating the flammability control system at a first level to suppress the development of flammable vapors in a fuel tank of a vehicle;

 receiving one or more signals relating to an operational phase of the vehicle;

 when the one or more signals correspond to a first probability of ignition in the fuel tank, continuing to operate the flammability control system at the first level; and

 when the one or more signals correspond to a second probability of ignition in the fuel tank that is less than the first probability of ignition, at least reducing the operating level of the flammability control system from the first level to a second level that is less than the first level.

[c48] 48. The method of claim 47 wherein operating the flammability control system at a first level includes flowing inert gas into the fuel tank, and wherein at least reducing the operating level of the flammability control system includes stopping the flow of inert gas into the fuel tank.

[c49] 49. A computer-readable medium including computer-readable instructions configured to cause a controller to control a flammability control system by a method comprising:

receiving one or more signals relating to at least one of a condition of a fuel tank and an operational phase of a vehicle;

when the one or more signals correspond to a first level of flammable vapors in the fuel tank, operating or continuing to operate the flammability control system at a first level of operation; and

when the one or more signals correspond to a second level of flammable vapors in the fuel tank that is less than the first level of flammable vapors, operating or continuing to operate the flammability control system at a second level of operation that is less than the first level of operation.

[c50] 50. The computer-readable medium of claim 49 wherein operating the flammability control system at a first level of operation includes flowing inert gas into the fuel tank, and wherein operating the flammability control system at a second level of operation includes at least reducing the flow of inert gas into the fuel tank.

[c51] 51. The computer-readable medium of claim 49 wherein operating the flammability control system at a first level of operation includes flowing compressed air to an inert gas generation system, and wherein operating the flammability control system at a second level of operation includes at least reducing the flow of compressed air to the inert gas generation system.

[c52] 52. The computer-readable medium of claim 49 wherein operating the flammability control system at a first level of operation includes operating at least one cooling fan at a first level to cool the fuel tank, and wherein operating the

flammability control system at a second level of operation includes at least reducing power to the cooling fan.

[c53] 53. A system for controlling a flammability control system, the system for controlling comprising:

receiving means for receiving one or more signals relating to at least one of a condition of the fuel tank and an operational phase of the vehicle; and

control means for causing the flammability control system to operate or continue operating at a first level of operation when the one or more signals correspond to a first level of flammable vapors in the fuel tank, and at a second level of operation that is less than the first level of operation when the one or more signals correspond to a second level of flammable vapors in the fuel tank that is less than the first level of flammable vapors.

[c54] 54. The system of claim 53 wherein the receiving means includes means for receiving a signal from a landing gear system of an aircraft.

[c55] 55. The system of claim 53 wherein the receiving means includes means for receiving a temperature signal relating to an air temperature outside the fuel tank.

[c56] 56. The system of claim 53 wherein the receiving means includes means for receiving at least one of an airspeed signal and a rate-of-climb signal relating to an aircraft.

[c57] 57. The system of claim 53 wherein operating or continuing to operate the flammability control system at a first level of operation includes flowing inert gas into the fuel tank, and wherein operating or continuing to operate the

flammability control system at a second level of operation includes at least reducing the flow of inert gas into the fuel tank.